UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 25, 2010

Site Vice President
Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Station
600 Rocky Hill Road
Plymouth, MA 02360-5508

SUBJECT: RELIEF REQUEST PRR-20, ALTERNATIVE EXAMINATION REQUIREMENTS FOR NOZZLE-TO-SHELL AND INNER RADII WELDS USING ASME CODE CASE N-702 AND BWRVIP-108 - PILGRIM NUCLEAR POWER STATION (TAC NO. ME3290)

Dear Sir or Madam:

By letter dated February 1, 2010 (Agencywide Documents Access and Management System, (ADAMS), Accession No. ML100350096), as supplemented by letter dated July 13, 2010 (ML102020257), Entergy Nuclear Operations, Inc. (the licensee) submitted Pilgrim Relief Request (PRR)-20 for Pilgrim Nuclear Power Station to the Nuclear Regulatory Commission (NRC). Entergy requests to utilize the alternative examination requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds," and BWRVIP-108, "BWR Vessel Internals Project Technical Basis for the Reduction of Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii," in lieu of the requirements in the ASME Code, Section XI, Table IWB-2500-1, Nozzle-to-Vessel Shell Welds and Nozzle Inner Radii examination requirements.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(i), the licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety.

The NRC staff has reviewed the licensee's submittal and concludes that the licensee's proposed alternative to use ASME Code Case N-702 and BWRVIP-108 in lieu of ASME Code, Section XI, Table IWB-2500-1, as discussed in PRR-20, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the use of the proposed alternative examinations is authorized for the remainder of the fourth 10-year interval inservice inspection interval.

All other requirements of the ASME Code, Sections III and XI, for which relief has not been specifically requested and approved remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

If you have any questions regarding this approval, please contact the Pilgrim Project Manager, James Kim, at 301-415-4125.

Sincerely,

Nancy L. Salgado

Nancy L. Salgado, Chief
Plant Licensing Branch 1-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-293

Enclosure:
As stated

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR RELIEF (PRR)-20

ENTERGY NUCLEAR OPERATIONS, INC.

PILGRIM NUCLEAR POWER STATION

DOCKET NO. 50-293

## 1.0 INTRODUCTION

By letter dated February 1, 2010 (Agencywide Documents Access and Management System, (ADAMS), Accession No. ML100350096), as supplemented by letter July 13, 2010 (ML102020257), Entergy Nuclear Operations, Inc. (the licensee) requested Nuclear Regulatory Commission (NRC) staff review and approval of Pilgrim Relief Request (PRR)-20 to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Table IWB-2500-1, Nozzle-to-Vessel Shell Welds and Nozzle Inner Radii examination requirements pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(i). An alternative in accordance with ASME Code Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds," and BWRVIP-108, "BWR Vessel Internals Project Technical Basis for the Reduction of Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii," was proposed.

## 2.0 REGULATORY REQUIREMENTS

Inservice inspection (ISI) of the ASME Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by 10 CFR Part 50, Section 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i).

Section 50.55a(a)(3) of 10 CFR states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if: (i) the proposed alternatives would provide an acceptable level of quality and safety or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. 10 CFR 50.55a(g)(4) further states that ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except design and access provisions and preservice examination requirements, set forth in the ASME Code, Section XI to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject

to the limitations and modifications listed therein. The applicable ISI Code of Record for the fourth 10-year ISI interval for Pilgrim is the ASME Code, Section XI, 1998 Edition with 2000 Addenda.

For all reactor pressure vessel (RPV) nozzle-to-vessel shell welds and nozzle inner radii, ASME Code, Section XI requires 100-percent inspection during each 10-year ISI interval. However, ASME Code Case N-702 proposes an alternative which reduces the inspection of RPV nozzle-to-vessel shell welds and nozzle inner radius areas from 100 percent to 25 percent of the nozzles for each nozzle type during each 10-year interval. The NRC has approved the BWRVIP-108 Report (ADAMS Accession No. ML0736003740), the underlying technical basis document for ASME Code Case N-702.

The NRC staff's December 19, 2007, safety evaluation (SE) regarding the BWRVIP-108 Report specified the following plant-specific requirements to be satisfied by applicants using ASME Code Case N-702:

> However, each licensee should demonstrate the plant-specific applicability of the BWRVIP-108 Report to their units in the relief request by showing that all the following factors are less than 1.15:
>
> (1) the temperature factor defined as (RPV heat up and cooldown rate) / (100 °F/hour),
>
> For the recirculation inlet nozzle,
>
> (2) the RPV pressure stress factor defined as [(RPV pressure)x(RPV inner radius) / (RPV thickness)] / 19332,
>
> (3) the nozzle pressure stress factor defined as (pressure/1000 psi)x{[(nozzle outer radius)$^2$ + (nozzle inner radius)$^2$] / [(nozzle outer radius)$^2$ - (nozzle inner radius)$^2$] / 1637,
>
> For the recirculation outlet nozzle,
>
> (4) the RPV pressure stress factor defined as [(RPV pressure)x(RPV inner radius) / (RPV thickness)]/16171, and
>
> (5) the nozzle pressure stress factor defined as (pressure/1000 psi)x{[(nozzle outer radius)$^2$ + (nozzle inner radius)$^2$] / [(nozzle outer radius)$^2$ - (nozzle inner radius)$^2$] / 1977.

This plant-specific information was required by the NRC staff to ensure that the probabilistic fracture mechanics (PFM) analysis documented in the BWRVIP-108 Report applies to the RPV of the applicant's plant.

## 3.0 LICENSEE'S PROPOSED ALTERNATIVE

### 3.1 Licensee Evaluation

ASME Code Requirements for which Relief is Requested

The licensee requested relief from the following requirements of the ASME Code, Section XI, 1998 Edition with 2000 Addenda:

> Table IWB-2500-1, Examination Category B-D, Full Penetration Welded Nozzles in Vessels – Inspection Program B. Item B3.90 requires volumetric examination of all Nozzle-to-Vessel welds. Item B3.100 requires volumetric examinations of all Nozzle Inside Radius Sections.

Components for which Relief is Requested

Code Class: 1

Component Numbers: N1 (Recirculation Outlet Nozzles), N3 (Main Steam Nozzles), N6 (Core Spray Nozzles), N7 (Instrumentation Nozzles), N8 (Head Vent Nozzles), and N9 (Jet Pump Instrumentation Nozzles)

Examination Category: B3.90 and B3.100

Licensee's Proposed Alternative to ASME Code

> Pursuant to 10 CFR 50.55a(a)(3)(i), an alternative is requested from performing the required examinations on 100% of the identified nozzle assemblies listed in Attachment 1.[1] As an alternative, incorporation of Code Case N-702 [...] would require examination at a minimum, 25% of the nozzle-to-vessel welds and inner radius sections, including at least one nozzle from each system and nominal pipe size as shown in Table 4-1.[2] For each of the identified nozzle assemblies in Table 4-1, both the inner radius region and the nozzle-to-shell weld either have already been or will be examined during the 4$^{th}$ ISI interval.

Licensee's Basis for Alternative

> Electric Power Research Institute (EPRI) Technical Report 1003557, "BWRVIP-108: BWR Vessel and Internals Project (BWRVIP), Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii" [...] provides the technical basis for use of [ASME] Code Case N-702. The evaluation found that failure probabilities due to a low temperature overpressure event at the nozzle blend radius region and nozzle-to-vessel shell weld is very low (i.e. < $1x10^{-6}$ for 40 years) with or without inservice inspection. The report concludes that inspection of 25% of each nozzle type is technically justified. [...]

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[1] "Attachment 1" refers to an attachment to the licensee's February 1, 2010, submittal. The attachment is not included in this SE.

[2] "Table 4-1" refers to a table in the licensee's February 1, 2010, submittal. The table is not included in this SE.

> On December 19, 2007, the NRC issued a Safety Evaluation (SE) [...] approving the use of BWRVIP-108. Within Section 5 of the SE, it states that each licensee should demonstrate the plant-specific applicability of the BWRVIP-108 Report to their units in the request for alternative by meeting the criteria discussed in Section 5 of the SE.
>
> The applicability of the BWRVIP-108 Report to [Pilgrim] is demonstrated by showing the criteria within Section 5 of the SE are met.[3]

Criterion 1: the maximum RPV heatup/cooldown rate is less than 115 °F/hour

The maximum [RPV] Heatup/Cooldown rate is limited to less than 100 °F/hour

Criterion 2: for recirculation inlet nozzles, $(pr/t)/C_{RPV} < 1.15$

$(pr/t)/C_{RPV} = 0.93 < 1.15$

Criterion 3: for recirculation inlet nozzles, $[p(r_o^2+r_i^2)/(r_o^2-r_i^2)]/C_{NOZZLE} < 1.15$

$[p(r_o^2+r_i^2)/(r_o^2-r_i^2)]/C_{NOZZLE} = 1.465 > 1.15$

Criterion 4: for recirculation outlet nozzles, $(pr/t)/C_{RPV} < 1.15$

$(pr/t)/C_{RPV} = 1.117 < 1.15$

Criterion 5: for recirculation inlet nozzles, $[p(r_o^2+r_i^2)/(r_o^2-r_i^2)]/C_{NOZZLE} < 1.15$

$[p(r_o^2+r_i^2)/(r_o^2-r_i^2)]/C_{NOZZLE} = 1.0655 < 1.15$

Licensee Proposed Duration of Alternative

The licensee proposes that the alternative will be utilized through the remainder of Pilgrim's fourth ISI interval (July 1, 2005 – June 30, 2015) for the nozzle assemblies listed in Attachment 1 of the February 1, 2010, application.

3.2 NRC Staff Evaluation

Criteria for Applying the BWRVIP-108 Report

The December 19, 2007, SE on the BWRVIP-108 Report specified five plant-specific criteria that licensees must meet in order to demonstrate that the BWRVIP-108 Report results apply to their plants. The five criteria are related to the driving force of the probabilistic fracture mechanics (PFM) analysis for the recirculation inlet and outlet nozzles. It was stated in the December 19, 2007, SE that the nozzle material fracture toughness-related ($RT_{NDT}$) values used in the PFM analyses were based on data from the entire fleet of BWR RPVs. Therefore, the BWRVIP-108 Report PFM analyses are bounding with respect to fracture resistance, and only the driving force of the underlying PFM analyses needs to be evaluated. It was also stated in the December 19,

[3] The calculations to confirm that the criteria of BWRVIP-108 are met are included as Attachment 2 of the licensee's February 1, 2010, submittal. The attachment is not included in this SE.

2007, SE, that except for the RPV heatup/cooldown rate, the plant-specific criteria are for the recirculation inlet and outlet nozzles only because the probabilities of failure, P(FIE)s, for other nozzles are an order of magnitude lower.

The licensee stated that Criterion 1 is satisfied because Pilgrim maintains a maximum heatup/cooldown rate of 100 °F/hour, well below the 115 °F/hour criterion limit. The licensee stated that in accordance with their Technical Specification 3.6.A.2 Reactor Coolant System heatup and cooldown rates are limited to a maximum of 100 °F when averaged over any 1-hour period. This addressed whether there have been any events during which the heatup/cooldown rate was in excess of 115 °F/hour. This is not a concern as Criterion 1 refers only to normal operations, not typical transients.

For the remaining four criteria, the licensee provided, in Attachment 2 of the submittal, plant-specific data and an evaluation of the driving force factors, or ratios, against the criteria established in the December 19, 2007, SE. The licensee's calculated results showed that three of the remaining four criteria are satisfied, the exception being Criterion 3 (as shown above) and independent staff calculations confirmed the accuracy of the licensee results. As a result, the licensee appropriately excluded the Pilgrim recirculation inlet nozzles from the scope of this request.

Finally the NRC staff requested in a letter dated May 19, 2010 (ADAMS No. ML101400532) a synopsis of previous inspections and whether any indications were found in the assemblies for which the alternative was requested. The licensee indicated that no recordable indications were found in any of the assemblies. All of the assemblies have been examined at least twice since operation began and all have been examined at least once in the last 10 years.

## 4.0 CONCLUSION

The NRC staff has reviewed the submittal and finds that the Pilgrim RPV meets all four of the five plant-specific criteria specified in the December 19, 2007, SE on the BWRVIP-108 Report, which provides the technical basis for use of ASME Code Case N-702. On the basis of not meeting Criterion 3, the Pilgrim recirculation inlet nozzles were excluded from the scope of this request.

Accordingly, PRR-20 is authorized pursuant to 10 CFR 50.55a(a)(3)(i) based on the NRC staff's determination that the alternative provides an acceptable level of quality and safety. Therefore, the use of the proposed alternative examinations is authorized for the remainder of the fourth 10-year interval inservice inspection interval.

Consequently, pursuant to 10 CFR 50.55a(a)(3)(i), the alternative is authorized through the end of the fourth 10-year ISI interval from the requirements of Table IWB-2500-1 (Inspection Program B) of ASME Code, Section XI, pertaining to inspection of RPV nozzle-to-vessel shell welds and inner radii for nozzles specified in Attachment 1 to the licensee's February 1, 2010, submittal because an acceptable level of quality and safety can be maintained.

All other requirements of the ASME Code, Sections III and XI, for which relief has not been specifically requested and approved remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: Dan Widrevitz

Date: August 25, 2010

If you have any questions regarding this approval, please contact the Pilgrim Project Manager, James Kim, at 301-415-4125.

Sincerely,

***/RA/***

Nancy L. Salgado, Chief
Plant Licensing Branch 1-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-293

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